

General framework for frugal AI

An AFNOR Spec to measure and reduce the environmental impact of AI

The frugality of an AI service aims to reduce the overall need for material and energy resources, and the associated environmental impacts, by redefining usage or performance requirements, or by redirecting needs from the producer of the AI system to the provider of the service in question. A frugal AI service is therefore a service for which:

- The need to use an AI system rather than another less energy-intensive solution to meet the same objective has been demonstrated;
- Best practices are adopted by the AI producer, provider, and client to reduce the environmental impacts of the service using an AI algorithm;
- The uses and needs aim to remain within planetary boundaries and have been previously examined.

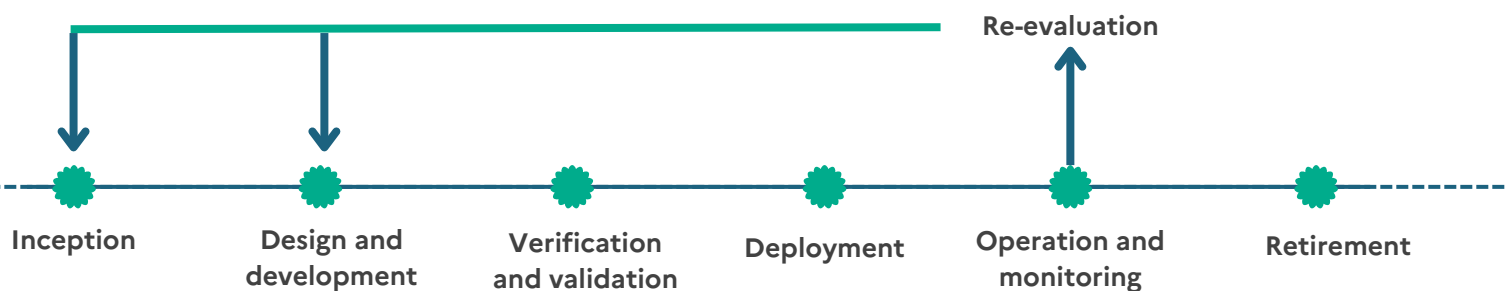
For whom ? Why ?

- Producers and providers of AI services to measure and reduce the environmental impact of their services, as well as to communicate about their actions.
- AI clients and civil society to evaluate the statements of providers and producers.

How to calculate ?

You want to calculate the environmental impact related to the provision of the AI service over a year to all users. Think about :

- The entire AI system life cycle



- All digital resources required to deliver the service to users



- End-user devices
- Networks
- Storage and data centers

- A few environmental indicators



- Climate change
- Depletion of natural resources



- Water resource consumption and extraction
- Ocean acidification
- Fine particle emissions
- Ionizing radiation



In addition to direct impacts, indirect impacts must be qualitatively assessed. For example, the rebound effect consists of an increase in consumption due to environmental efficiency interventions that can occur through a price reduction, energy consumption or other mechanism including behavioral responses.

We want to implement best practices across 7 themes, from the best gain/effort ratio to the lowest.



Managing skills and increasing awareness on frugal AI

- Raising awareness and training stakeholders
- Identifying and mobilizing available skills on frugal AI

Qualifying the relevance of AI to meet the need for a new digital service

- Using requirement analysis methods to implement frugality analysis methods to implement frugality
- Choosing and developing the solution to meet the need, considering alternatives to AI

Optimizing data management and integrating it into a continual improvement approach

- Controlling volume data
- Working on quality data
- Using a relevant dataset to design the AI service
- Defining data storage rules according to usage
- Data compression
- Using open source datasets for prototyping

Optimizing model performance and integrating it into a continual improvement approach

- Writing code that can be improved by several people and re-implemented on several environments
- Streamlining models
- Breaking down a large AI model into several smaller models
- Reusing trained algorithms and sharing completed algorithms
- Favoring more frugal models
- A/B testing of models to identify the best performance/resource ratio
- Using compression methods to reduce the footprint of AI algorithms
- Defining criteria justifying retraining model

Analyzing the impact of the equipment required for the AI service and optimizing its use

- Optimizing use of existing equipment
- Preferring existing user/staff devices for AI service training of inference
- Ensuring frugality of infrastructures throughout operation
- Implementing ecodesign measures in the development phase

Providing tools for measuring environmental impact and enhancing knowledge

- Creating a repository of the environmental impacts of projects
- Estimating initial model consumption
- Updating measurement strategies according to challenges and constraints to maintain the frugality of the AI service

Setting up a governance system to question frugality

- Integrating frugality into AI relevance criteria
- Steering the environmental performance of AI systems
- Providing for end-of-life in AI project management
- Drawing up frugality in each AI project through the life cycle
- Setting up and facilitating a single frugal AI services repository
- Using off-the-shelf digital AI products promoting frugality

How to reduce the impact?

You want to engage in a frugal AI project. Six steps can be integrated :



1 Question the need: ensure that it genuinely exists and that the usage scenarios are fully described with their limitations

Integrate an environmental impacts assessment into decision-making and management processes **4**

Identify all possible solutions: whether they are AI-based, without AI or based on frugal AI, or even those based on existing solutions **2**

5 Equip the deployment of solutions to precisely monitor their actual usage

3 Evaluate each solution in terms of environmental impact over the entire lifecycle of the project and the solution

Readapt the roles and responsibilities of the various stakeholders in projects so that the entire governance integrates frugality **6**

How to communicate ?

To communicate about a quantitative evaluation of environmental indicators, the supplier or producer integrates the following information:

- Details on the scope of the life cycle assessment
- Source of the methodologies used
- Life cycle assessment database used for impact calculation
- Guide to using the AI service to obtain the expected environmental performance on inferences
- Location of computing and storage resources over the AI life cycle
- Details of the assessment: critical review by an external third party or not, instantaneous data or date of completion of the life cycle assessment, information on the quality of the data on which the LCA is based



To communicate about the frugal nature of an AI service:

- A quantitative assessment of environmental indicators over the life cycle of the service
- Details of the implementation of the best practices adopted for the service, referencing their sources, and a qualitative assessment of the impact of these best practice
- A qualitative list of potential negative second order and higher order effects that can be expected from the AI service



To communicate about the positive balance for an impact category of a frugal AI service:

- Any information related to communication about the frugality of the AI service
- A quantitative assessment of the environmental impacts of uses of an AI service, and a comparison with the environmental impacts of the life cycle of the service
- Potential transfers of impact of the service



AI service with a positive balance for an impact category

Frugal AI service

Environmental assessment of the AI system

Assessment of need compared to other solutions

Implementation of best practices

Use respecting planetary boundaries

Overall reduction in needs for resources and associated emissions through by redefinition of uses

Positive impact of uses greater than negative impacts of life cycle and uses

L'Ecolab - Greentech Innovation of the CGDD



Ecolab acts as a catalyst for innovative public and private projects addressing the dual urgency of ecological and digital transformations. It serves the Ministries (Ecological Transition, Territorial Cohesion, Sea, Biodiversity, Rurality, Transport, Housing) and the general secretariat for ecological planning. Ecolab activates two main levers: support for private entrepreneurial innovation (greentech companies) and the mobilization of data and artificial intelligence.

On the Greentech front, Ecolab animates the French greentech ecosystem. Within this ecosystem, it labels innovative startups/SMEs with a strong ecological impact (« Greentech Innovation ») and relies on a national network of incubators. Ecolab acts in support of the sale and visibility of these solutions, particularly the sale to public actors for better orientation of regional and national public procurement towards the sustainable innovative solutions of companies.

On the Data/AI front, Ecolab leads innovative projects that leverage data and utilize AI. It serves as the ministerial data administrator for algorithms and source codes on behalf of the CGDD. It animates communities of public and private actors leveraging AI and data for the ecological transition, within which multi-actor projects emerge and sometimes digital commons, such as Green Data for Health for environmental health. It supports the emergence of frugal AI demonstrators in the territories within the framework of France 2030 and designs decision-support tools and data access tools.

More informations on Ecolab : <https://greentechinnovation.fr/>
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